This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-3}{4}, \frac{7}{4}, \text{ and } \frac{1}{5}$$

The solution is $80x^3 - 96x^2 - 89x + 21$, which is option C.

A. $a \in [71, 88], b \in [-99, -95], c \in [-89, -81], \text{ and } d \in [-25, -15]$

$80x^3 - 96x^2 - 89x - 21$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [71, 88], b \in [-222, -215], c \in [143, 147], \text{ and } d \in [-25, -15]$

$80x^3 - 216x^2 + 145x - 21$, which corresponds to multiplying out $(4x - 3)(4x - 7)(5x - 1)$.

C. $a \in [71, 88], b \in [-99, -95], c \in [-89, -81], \text{ and } d \in [16, 31]$

* $80x^3 - 96x^2 - 89x + 21$, which is the correct option.

D. $a \in [71, 88], b \in [57, 67], c \in [-121, -119], \text{ and } d \in [16, 31]$

$80x^3 + 64x^2 - 121x + 21$, which corresponds to multiplying out $(4x - 3)(4x + 7)(5x - 1)$.

E. $a \in [71, 88], b \in [94, 102], c \in [-89, -81], \text{ and } d \in [-25, -15]$

$80x^3 + 96x^2 - 89x - 21$, which corresponds to multiplying out $(4x - 3)(4x + 7)(5x + 1)$.

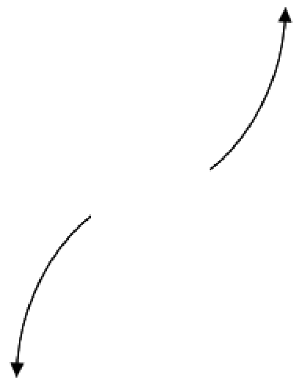
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(4x + 3)(4x - 7)(5x - 1)$

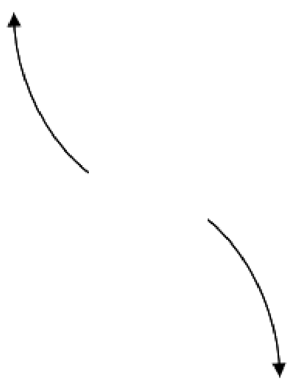
---

2. Describe the end behavior of the polynomial below.

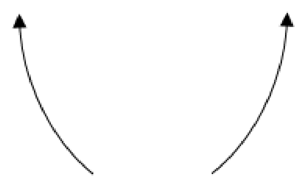
$$f(x) = 7(x - 7)^4(x + 7)^7(x - 3)^2(x + 3)^2$$

The solution is the graph below, which is option D.

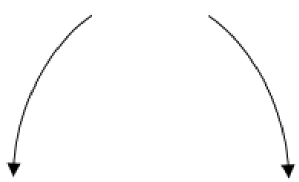




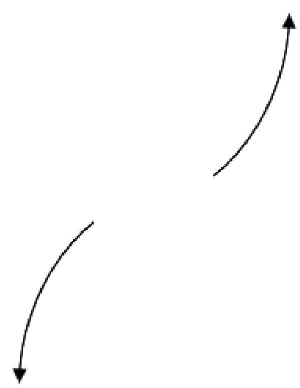
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

3. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$5 - 4i \text{ and } -4$$

The solution is $x^3 - 6x^2 + x + 164$, which is option C.

A. $b \in [3, 20], c \in [-0.68, 1.9],$ and $d \in [-168, -161]$

$x^3 + 6x^2 + x - 164$, which corresponds to multiplying out $(x - (5 - 4i))(x - (5 + 4i))(x - 4)$.

B. $b \in [-1, 4], c \in [5.04, 8.21]$, and $d \in [16, 23]$

$x^3 + x^2 + 8x + 16$, which corresponds to multiplying out $(x + 4)(x + 4)$.

C. $b \in [-6, -4], c \in [-0.68, 1.9]$, and $d \in [164, 166]$

* $x^3 - 6x^2 + x + 164$, which is the correct option.

D. $b \in [-1, 4], c \in [-1.45, 0.42]$, and $d \in [-20, -17]$

$x^3 + x^2 - x - 20$, which corresponds to multiplying out $(x - 5)(x + 4)$.

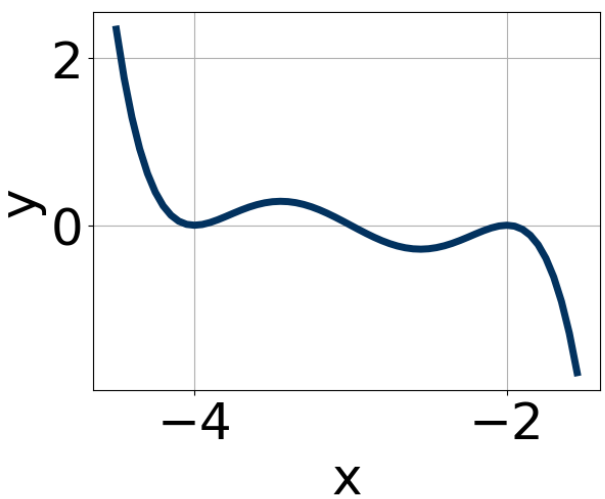
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (5 - 4i))(x - (5 + 4i))(x - (-4))$.

---

4. Which of the following equations *could* be of the graph presented below?



The solution is $-6(x + 2)^{10}(x + 4)^6(x + 3)^5$, which is option D.

A. $-13(x + 2)^{10}(x + 4)^7(x + 3)^6$

The factor $(x + 4)$ should have an even power and the factor $(x + 3)$ should have an odd power.

B. $18(x + 2)^{10}(x + 4)^6(x + 3)^{10}$

The factor $(x + 3)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $16(x + 2)^4(x + 4)^4(x + 3)^5$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $-6(x + 2)^{10}(x + 4)^6(x + 3)^5$

* This is the correct option.

E. $-15(x + 2)^6(x + 4)^7(x + 3)^{11}$

The factor $(x + 4)$ should have an even power.

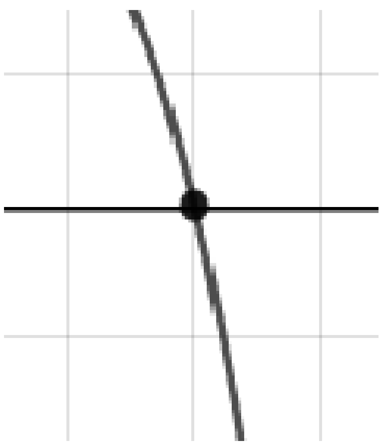
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

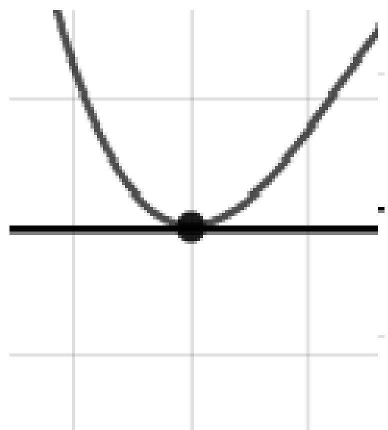
---

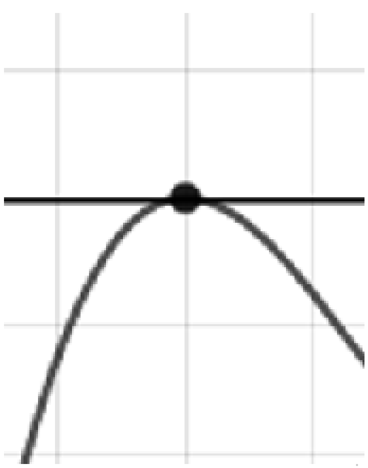
5. Describe the zero behavior of the zero $x = -8$ of the polynomial below.

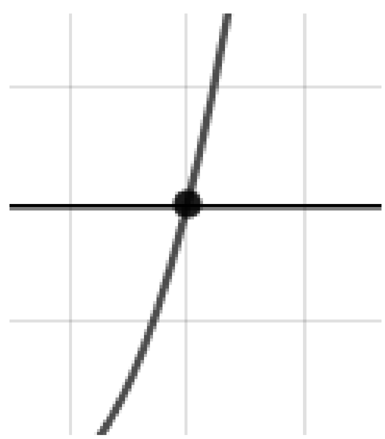
$$f(x) = 6(x+7)^3(x-7)^2(x-8)^5(x+8)^4$$

The solution is the graph below, which is option C.

A. 

C. 

B. 

D. 

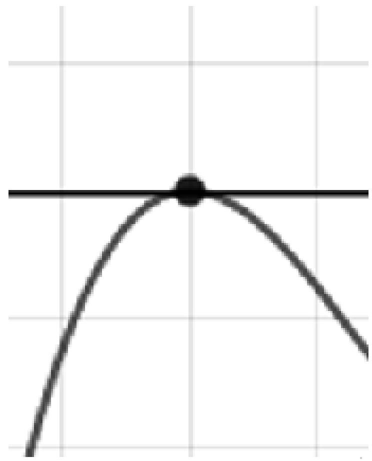
E. None of the above.

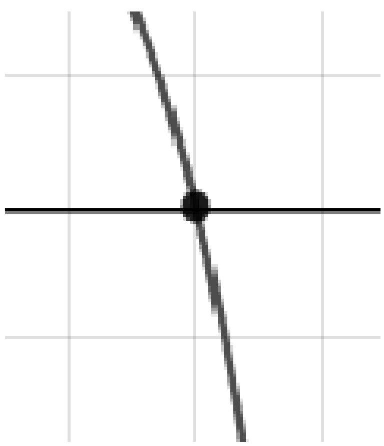
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

6. Describe the zero behavior of the zero $x = -9$ of the polynomial below.

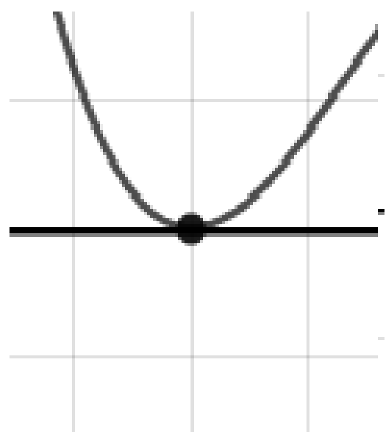
$$f(x) = -2(x+9)^6(x-9)^9(x-8)^2(x+8)^5$$

The solution is the graph below, which is option B.

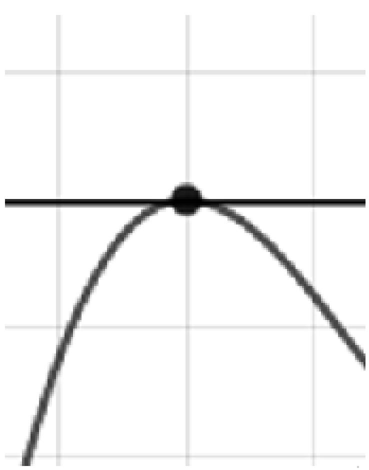




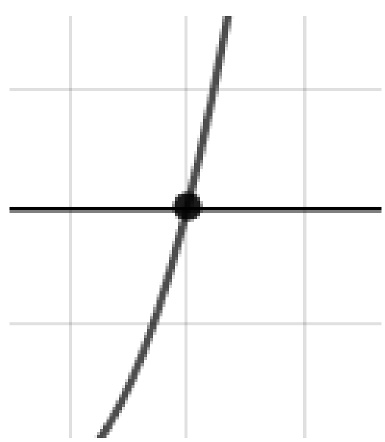
A.



C.



B.



D.

E. None of the above.

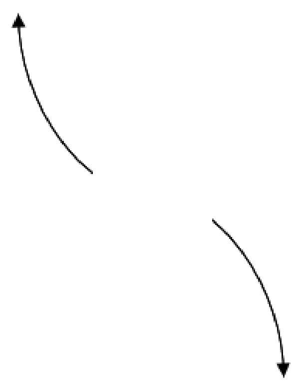
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

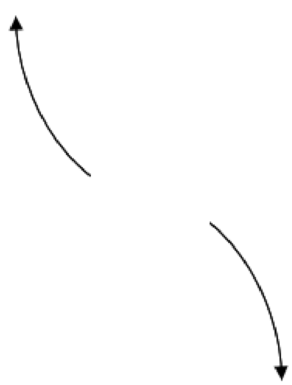
---

7. Describe the end behavior of the polynomial below.

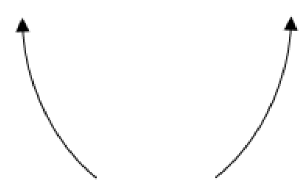
$$f(x) = -4(x-2)^3(x+2)^4(x-9)^5(x+9)^5$$

The solution is the graph below, which is option A.

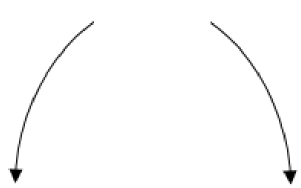




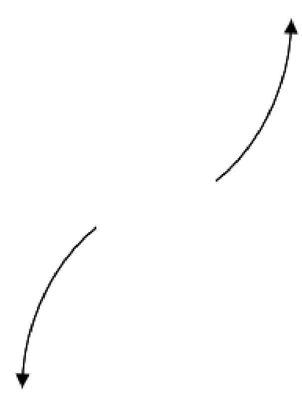
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

8. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 + 2i \text{ and } 1$$

The solution is $x^3 + 5x^2 + 7x - 13$, which is option B.

A. $b \in [-6.2, -2.7], c \in [7, 14],$ and $d \in [10, 14]$

$x^3 - 5x^2 + 7x + 13$, which corresponds to multiplying out $(x - (-3 + 2i))(x - (-3 - 2i))(x + 1)$.

B. $b \in [1.3, 5.6], c \in [7, 14],$ and $d \in [-16, -7]$

* $x^3 + 5x^2 + 7x - 13$, which is the correct option.

C. $b \in [-0.3, 3.3], c \in [-2, 3],$ and $d \in [-5, 0]$

$x^3 + x^2 + 2x - 3$, which corresponds to multiplying out $(x + 3)(x - 1)$.

D. $b \in [-0.3, 3.3], c \in [-6, -1],$ and $d \in [0, 3]$

$x^3 + x^2 - 3x + 2$, which corresponds to multiplying out $(x - 2)(x - 1)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 + 2i))(x - (-3 - 2i))(x - (1))$.

---

9. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-5}{4}, \frac{-3}{4}, \text{ and } 5$$

The solution is $16x^3 - 48x^2 - 145x - 75$, which is option C.

A. $a \in [15, 19], b \in [42, 52], c \in [-151, -140],$ and $d \in [68, 80]$

$16x^3 + 48x^2 - 145x + 75$, which corresponds to multiplying out $(4x - 5)(4x - 3)(x + 5)$.

B. $a \in [15, 19], b \in [-48, -41], c \in [-151, -140],$ and $d \in [68, 80]$

$16x^3 - 48x^2 - 145x + 75$, which corresponds to multiplying everything correctly except the constant term.

C. $a \in [15, 19], b \in [-48, -41], c \in [-151, -140],$ and $d \in [-76, -69]$

* $16x^3 - 48x^2 - 145x - 75$, which is the correct option.

D. $a \in [15, 19], b \in [-94, -79], c \in [23, 34],$ and $d \in [68, 80]$

$16x^3 - 88x^2 + 25x + 75$, which corresponds to multiplying out $(4x - 5)(4x + 3)(x - 5)$.

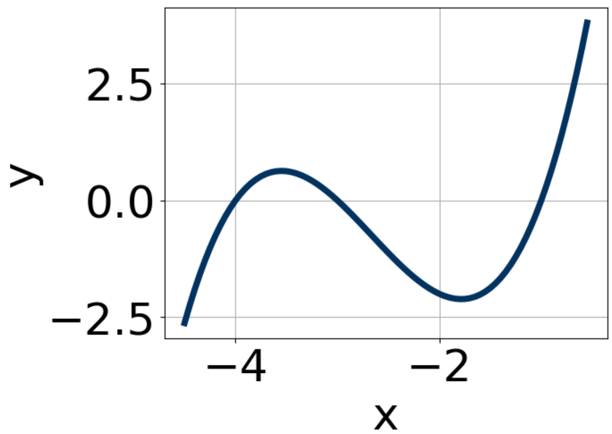
E. $a \in [15, 19], b \in [-119, -111], c \in [173, 179],$ and $d \in [-76, -69]$

$16x^3 - 112x^2 + 175x - 75$, which corresponds to multiplying out $(4x - 5)(4x - 3)(x - 5)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(4x + 5)(4x + 3)(x - 5)$

---

10. Which of the following equations *could* be of the graph presented below?



The solution is $10(x+1)^{11}(x+3)^7(x+4)^{11}$, which is option C.

A. $5(x+1)^8(x+3)^4(x+4)^5$

The factors -1 and -3 have have been odd power.

B. $-17(x+1)^4(x+3)^5(x+4)^5$

The factor $(x+1)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $10(x+1)^{11}(x+3)^7(x+4)^{11}$

* This is the correct option.

D. $5(x+1)^4(x+3)^{11}(x+4)^{11}$

The factor -1 should have been an odd power.

E. $-9(x+1)^7(x+3)^{11}(x+4)^9$

This corresponds to the leading coefficient being the opposite value than it should be.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

11. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form ax^3+bx^2+cx+d.

$$\frac{5}{2}, \frac{-1}{2}, \text{ and } -7$$

The solution is $4x^3+20x^2-61x-35$, which is option B.

A. $a \in [2, 10], b \in [36.1, 42.5], c \in [86, 95], \text{ and } d \in [30, 40]$

$4x^3+40x^2+89x+35$, which corresponds to multiplying out $(2x+5)(2x+1)(x+7)$.

B. $a \in [2, 10], b \in [18.8, 21.8], c \in [-65, -58], \text{ and } d \in [-35, -32]$

* $4x^3+20x^2-61x-35$, which is the correct option.

C. $a \in [2, 10], b \in [35.9, 37.2], c \in [42, 60], \text{ and } d \in [-35, -32]$

$4x^3+36x^2+51x-35$, which corresponds to multiplying out $(2x+5)(2x-1)(x+7)$.

D. $a \in [2, 10], b \in [-22.7, -19.9], c \in [-65, -58],$ and $d \in [30, 40]$

$4x^3 - 20x^2 - 61x + 35$, which corresponds to multiplying out $(2x + 5)(2x - 1)(x - 7)$.

E. $a \in [2, 10], b \in [18.8, 21.8], c \in [-65, -58],$ and $d \in [30, 40]$

$4x^3 + 20x^2 - 61x + 35$, which corresponds to multiplying everything correctly except the constant term.

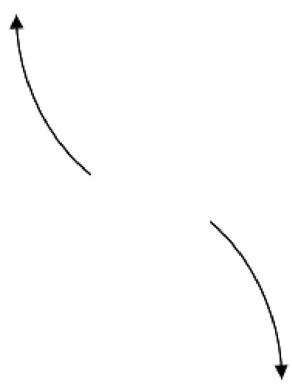
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(2x - 5)(2x + 1)(x + 7)$

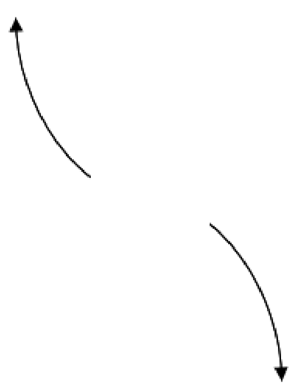
---

12. Describe the end behavior of the polynomial below.

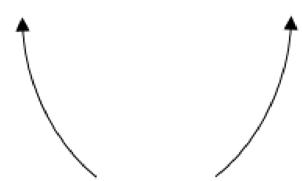
$$f(x) = -6(x - 6)^3(x + 6)^6(x + 2)^3(x - 2)^3$$

The solution is the graph below, which is option A.

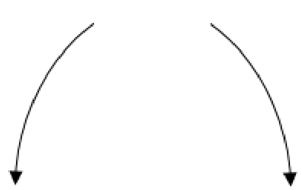




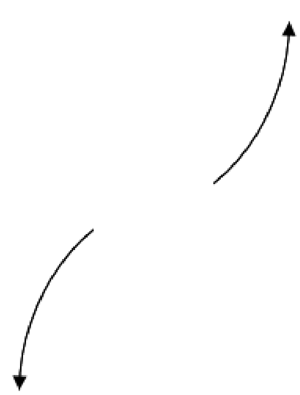
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

13. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$4 - 3i \text{ and } 2$$

The solution is $x^3 - 10x^2 + 41x - 50$, which is option A.

A. $b \in [-15, -8], c \in [35, 44],$ and $d \in [-50, -44]$

   * $x^3 - 10x^2 + 41x - 50$, which is the correct option.

B. $b \in [-5, 4], c \in [1, 7],$ and $d \in [-8, 2]$

   $x^3 + x^2 + x - 6$, which corresponds to multiplying out $(x + 3)(x - 2)$.

C. $b \in [10, 15], c \in [35, 44],$ and $d \in [50, 56]$

   $x^3 + 10x^2 + 41x + 50$, which corresponds to multiplying out $(x - (4 - 3i))(x - (4 + 3i))(x + 2)$.

D. $b \in [-5, 4], c \in [-9, 0],$ and $d \in [6, 11]$

   $x^3 + x^2 - 6x + 8$, which corresponds to multiplying out $(x - 4)(x - 2)$.

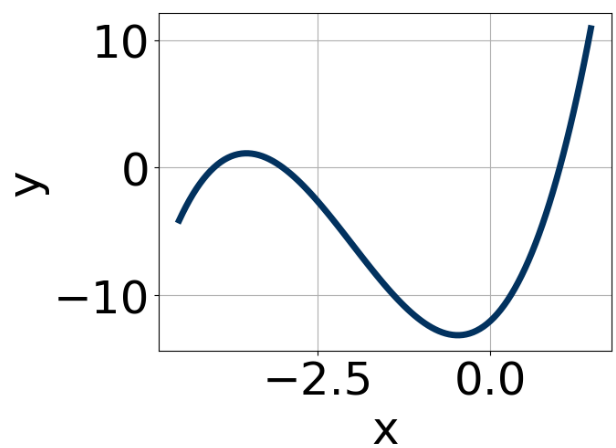
E. None of the above.

   This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (4 - 3i))(x - (4 + 3i))(x - (2))$.

---

14. Which of the following equations *could* be of the graph presented below?



The solution is $3(x - 1)^7(x + 3)^9(x + 4)^9$, which is option D.

A. $15(x - 1)^4(x + 3)^4(x + 4)^9$

   The factors 1 and -3 have have been odd power.

B. $-12(x-1)^{10}(x+3)^{11}(x+4)^{11}$

The factor $(x-1)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $-11(x-1)^{11}(x+3)^{7}(x+4)^{7}$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $3(x-1)^{7}(x+3)^{9}(x+4)^{9}$

* This is the correct option.

E. $20(x-1)^{8}(x+3)^{5}(x+4)^{9}$

The factor 1 should have been an odd power.

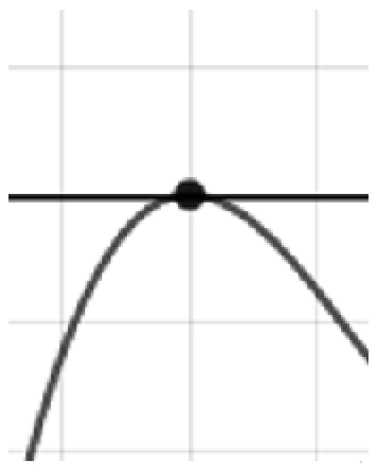
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

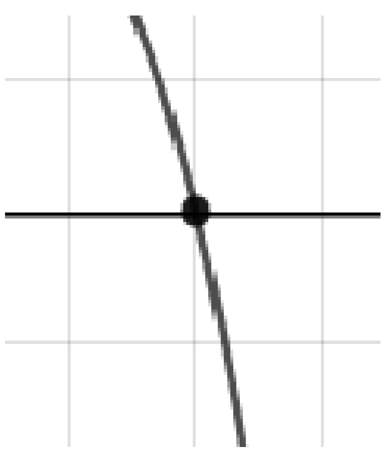
---

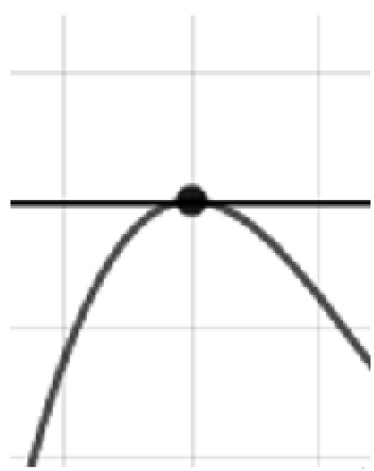
15. Describe the zero behavior of the zero $x = 4$ of the polynomial below.

$$f(x) = -6(x-4)^2(x+4)^3(x-8)^2(x+8)^5$$

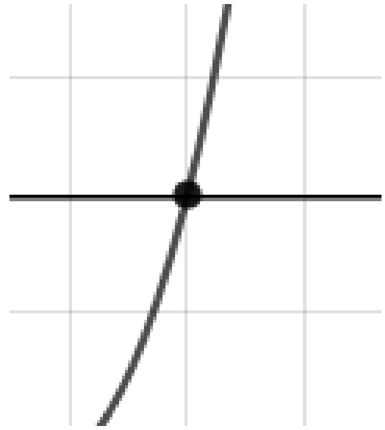
The solution is the graph below, which is option B.



A. 

B. 

C. 

D. 

E. None of the above.

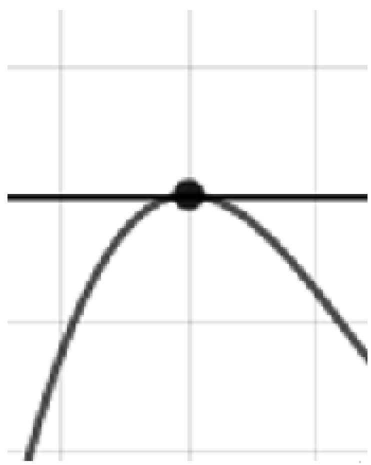
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

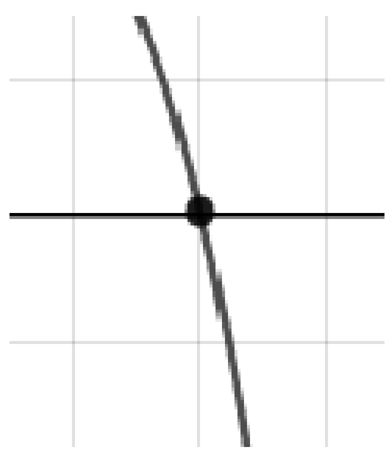
---

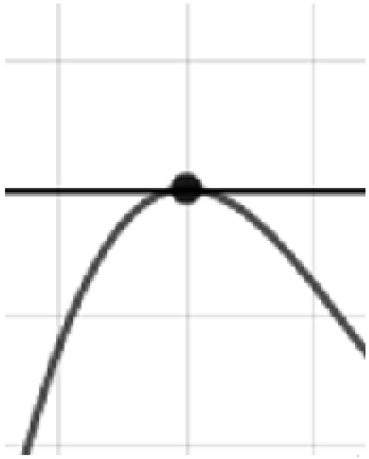
16. Describe the zero behavior of the zero $x = 5$ of the polynomial below.

$$f(x) = -5(x+5)^3(x-5)^4(x+7)^2(x-7)^4$$

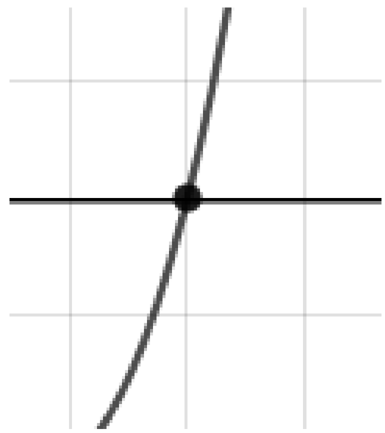
The solution is the graph below, which is option B.



A. 

B. 

C. 

D. 

E. None of the above.

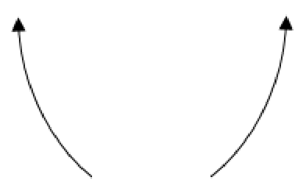
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

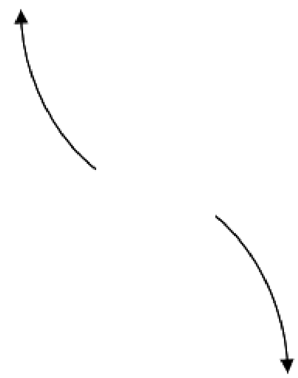
---

17. Describe the end behavior of the polynomial below.

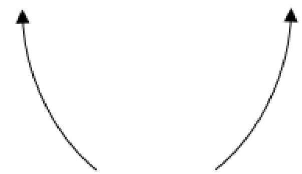
$$f(x) = 6(x-6)^4(x+6)^7(x-5)^3(x+5)^4$$

The solution is the graph below, which is option C.

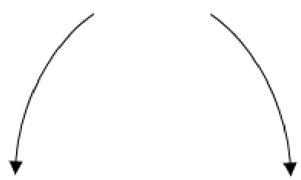




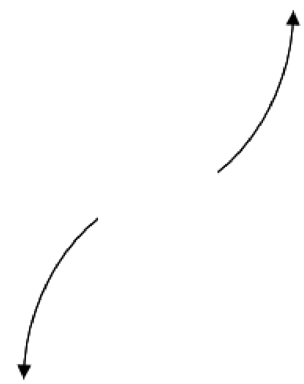
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

18. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 - 4i \text{ and } 1$$

The solution is $x^3 + 5x^2 + 19x - 25$, which is option D.

A. $b \in [-2.7, 4.7], c \in [0.81, 2.83], \text{ and } d \in [-3.5, -2.56]$

$x^3 + x^2 + 2x - 3$, which corresponds to multiplying out $(x + 3)(x - 1)$.

B. $b \in [-7.9, -3.5], c \in [17.28, 19.46], \text{ and } d \in [24.68, 25.62]$

$x^3 - 5x^2 + 19x + 25$, which corresponds to multiplying out $(x - (-3 - 4i))(x - (-3 + 4i))(x + 1)$.

C. $b \in [-2.7, 4.7], c \in [2.24, 5.06], \text{ and } d \in [-4.56, -3.05]$

$x^3 + x^2 + 3x - 4$, which corresponds to multiplying out $(x + 4)(x - 1)$.

D. $b \in [3.6, 7.4], c \in [17.28, 19.46], \text{ and } d \in [-25.02, -24.7]$

* $x^3 + 5x^2 + 19x - 25$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 - 4i))(x - (-3 + 4i))(x - (1))$.

---

19. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-2}{3}, \frac{1}{3}, \text{ and } \frac{5}{4}$$

The solution is $36x^3 - 33x^2 - 23x + 10$, which is option B.

A. $a \in [35, 37], b \in [-38, -31], c \in [-31, -22], \text{ and } d \in [-13, -7]$

$36x^3 - 33x^2 - 23x - 10$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [35, 37], b \in [-38, -31], c \in [-31, -22], \text{ and } d \in [8, 17]$

* $36x^3 - 33x^2 - 23x + 10$, which is the correct option.

C. $a \in [35, 37], b \in [-60, -55], c \in [4, 16], \text{ and } d \in [8, 17]$

$36x^3 - 57x^2 + 7x + 10$, which corresponds to multiplying out $(3x - 2)(3x + 1)(4x - 5)$.

D. $a \in [35, 37], b \in [-86, -76], c \in [53, 57], \text{ and } d \in [-13, -7]$

$36x^3 - 81x^2 + 53x - 10$, which corresponds to multiplying out $(3x - 2)(3x - 1)(4x - 5)$.

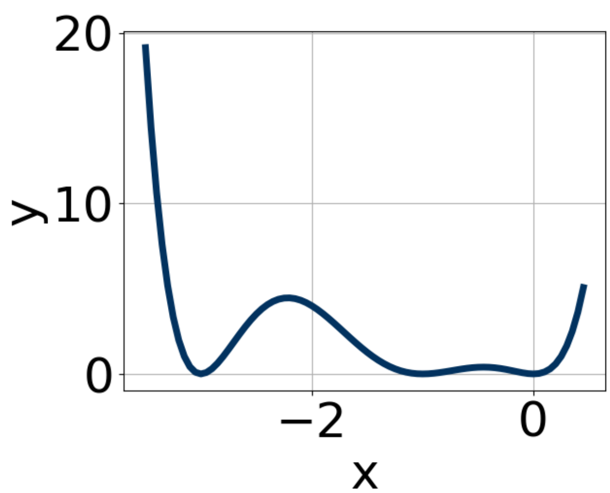
E. $a \in [35, 37], b \in [32, 39], c \in [-31, -22], \text{ and } d \in [-13, -7]$

$36x^3 + 33x^2 - 23x - 10$, which corresponds to multiplying out $(3x - 2)(3x + 1)(4x + 5)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x + 2)(3x - 1)(4x - 5)$

---

20. Which of the following equations *could* be of the graph presented below?



The solution is $4x^{10}(x + 3)^{10}(x + 1)^6$, which is option A.

A. $4x^{10}(x + 3)^{10}(x + 1)^6$

* This is the correct option.

B. $10x^8(x+3)^8(x+1)^{11}$

The factor $(x+1)$ should have an even power.

C. $6x^5(x+3)^4(x+1)^9$

The factors x and $(x+1)$ should both have even powers.

D. $-15x^{10}(x+3)^4(x+1)^{10}$

This corresponds to the leading coefficient being the opposite value than it should be.

E. $-6x^6(x+3)^8(x+1)^5$

The factor $(x+1)$ should have an even power and the leading coefficient should be the opposite sign.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

21. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{4}{3}, \frac{2}{3}, \text{ and } \frac{3}{5}$$

The solution is $45x^3 - 117x^2 + 94x - 24$, which is option A.

A. $a \in [43, 49], b \in [-121, -109], c \in [94, 102], \text{ and } d \in [-30, -23]$

* $45x^3 - 117x^2 + 94x - 24$, which is the correct option.

B. $a \in [43, 49], b \in [115, 126], c \in [94, 102], \text{ and } d \in [24, 25]$

$45x^3 + 117x^2 + 94x + 24$, which corresponds to multiplying out $(3x+4)(3x+2)(5x+3)$.

C. $a \in [43, 49], b \in [2, 5], c \in [-61, -52], \text{ and } d \in [24, 25]$

$45x^3 + 3x^2 - 58x + 24$, which corresponds to multiplying out $(3x+4)(3x-2)(5x-3)$.

D. $a \in [43, 49], b \in [63, 65], c \in [-21, -6], \text{ and } d \in [-30, -23]$

$45x^3 + 63x^2 - 14x - 24$, which corresponds to multiplying out $(3x+4)(3x+2)(5x-3)$.

E. $a \in [43, 49], b \in [-121, -109], c \in [94, 102], \text{ and } d \in [24, 25]$

$45x^3 - 117x^2 + 94x + 24$, which corresponds to multiplying everything correctly except the constant term.

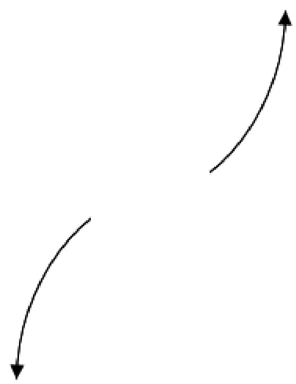
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x-4)(3x-2)(5x-3)$

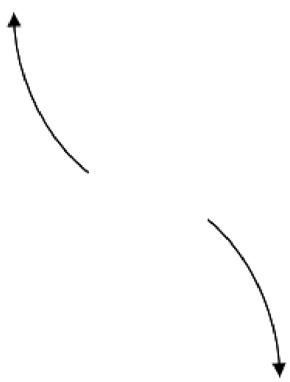
---

22. Describe the end behavior of the polynomial below.

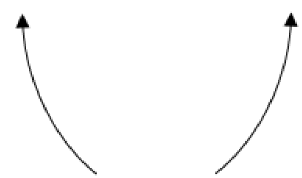
$$f(x) = 8(x-9)^5(x+9)^{10}(x-3)^3(x+3)^5$$

The solution is the graph below, which is option D.

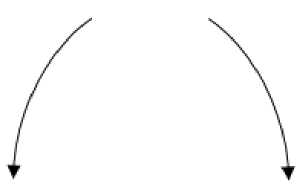




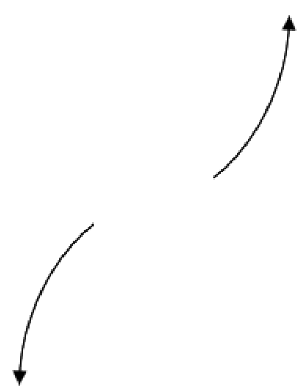
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

23. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$2 + 4i \text{ and } 1$$

The solution is $x^3 - 5x^2 + 24x - 20$, which is option C.

A. $b \in [4.8, 7.3], c \in [22.72, 24.73],$ and $d \in [18.8, 23.2]$

$x^3 + 5x^2 + 24x + 20$, which corresponds to multiplying out $(x - (2 + 4i))(x - (2 - 4i))(x + 1)$.

B. $b \in [-0.5, 1.6], c \in [-4.03, -2.68]$, and $d \in [0.5, 2.3]$

$x^3 + x^2 - 3x + 2$, which corresponds to multiplying out $(x - 2)(x - 1)$.

C. $b \in [-8.6, -2.1], c \in [22.72, 24.73]$, and $d \in [-21.3, -19.8]$

* $x^3 - 5x^2 + 24x - 20$, which is the correct option.

D. $b \in [-0.5, 1.6], c \in [-5.22, -3.99]$, and $d \in [2.7, 7]$

$x^3 + x^2 - 5x + 4$, which corresponds to multiplying out $(x - 4)(x - 1)$.

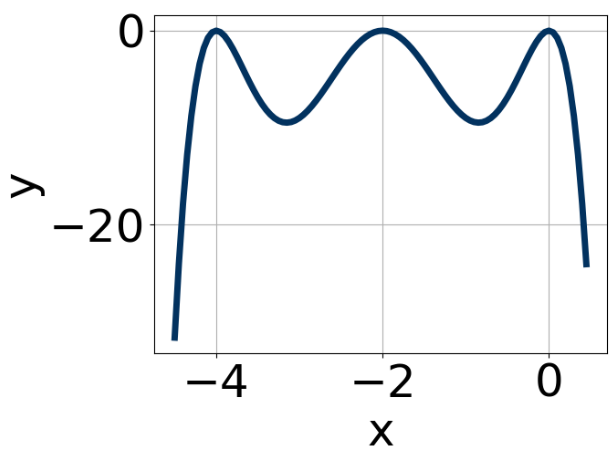
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (2 + 4i))(x - (2 - 4i))(x - (1))$.

---

24. Which of the following equations *could* be of the graph presented below?



The solution is $-3x^4(x + 2)^8(x + 4)^8$, which is option D.

A. $18x^5(x + 2)^8(x + 4)^4$

The factor x should have an even power and the leading coefficient should be the opposite sign.

B. $9x^{10}(x + 2)^8(x + 4)^6$

This corresponds to the leading coefficient being the opposite value than it should be.

C. $-6x^5(x + 2)^8(x + 4)^6$

The factor x should have an even power.

D. $-3x^4(x + 2)^8(x + 4)^8$

* This is the correct option.

E. $-14x^5(x + 2)^6(x + 4)^5$

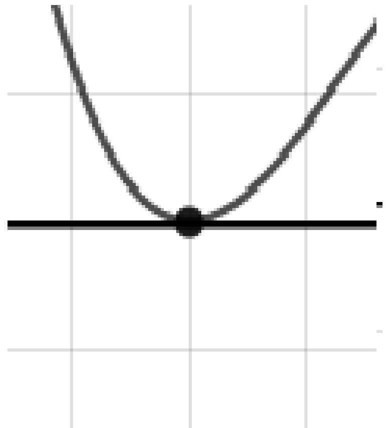
The factors $(x + 4)$ and x should both have even powers.

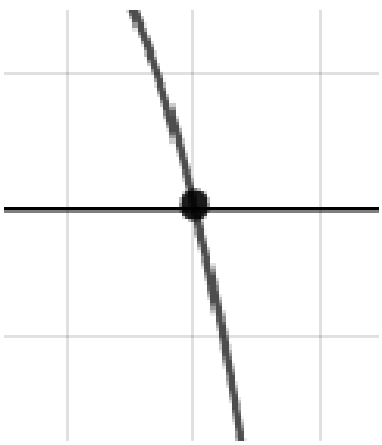
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

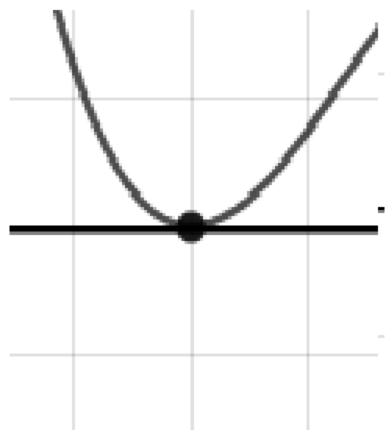
25. Describe the zero behavior of the zero $x = 9$ of the polynomial below.

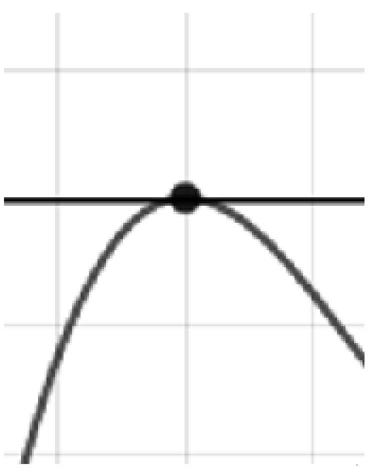
$$f(x) = 9(x-3)^{11}(x+3)^{8}(x-9)^{10}(x+9)^{9}$$

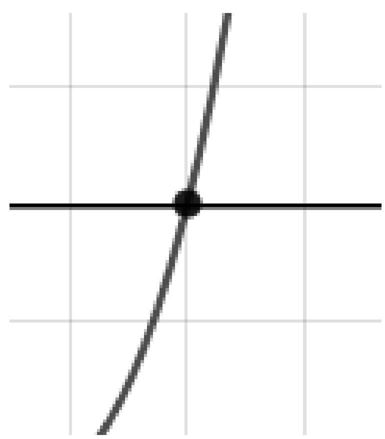
The solution is the graph below, which is option C.



A. 

C. 

B. 

D. 

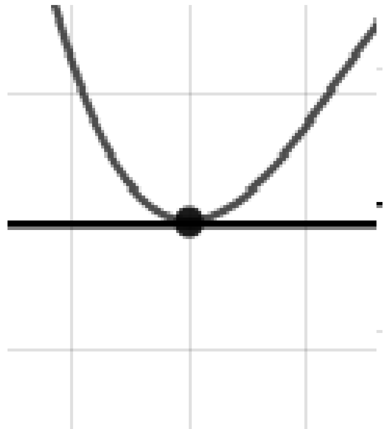
E. None of the above.

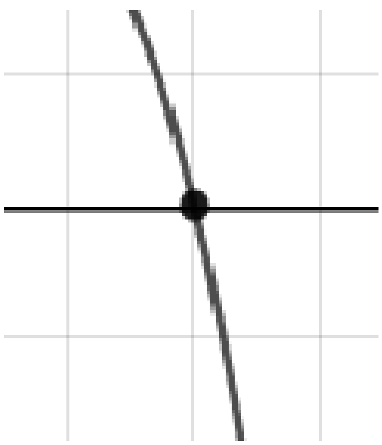
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

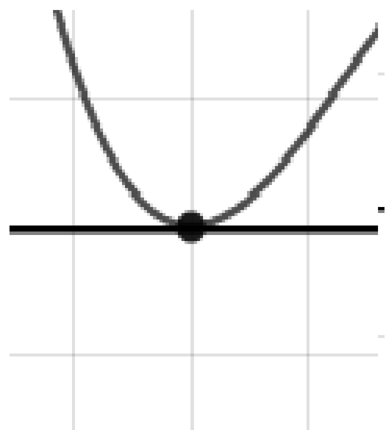
26. Describe the zero behavior of the zero $x = 4$ of the polynomial below.

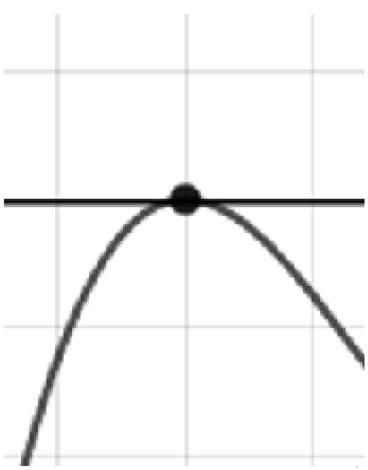
$$f(x) = 5(x+6)^5(x-6)^4(x+4)^9(x-4)^6$$

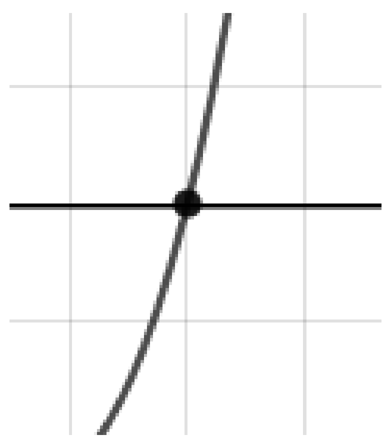
The solution is the graph below, which is option C.



A. 

C. 

B. 

D. 

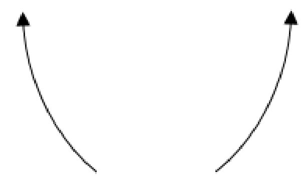
E. None of the above.

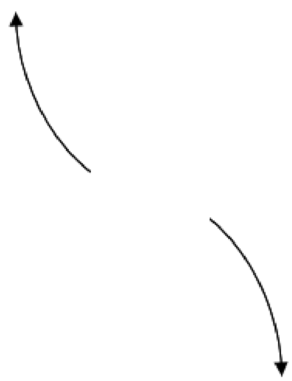
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

27. Describe the end behavior of the polynomial below.

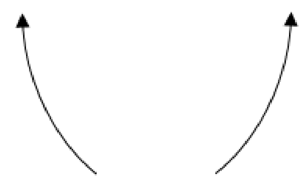
$$f(x) = 2(x+4)^3(x-4)^8(x-5)^5(x+5)^6$$

The solution is the graph below, which is option C.

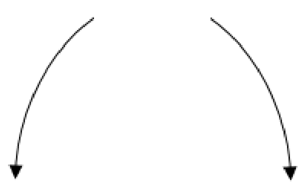




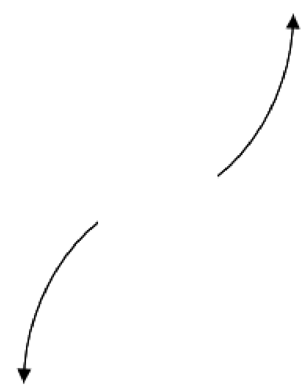
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

28. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-4 - 3i \text{ and } 1$$

The solution is $x^3 + 7x^2 + 17x - 25$, which is option C.

A. $b \in [-2.3, 1.9], c \in [1.81, 2.56],$ and $d \in [-3.42, -2.96]$

$x^3 + x^2 + 2x - 3$, which corresponds to multiplying out $(x+3)(x-1)$.

B. $b \in [-8.3, -5.2], c \in [15.94, 17.54], \text{ and } d \in [24.44, 26.01]$

$x^3 - 7x^2 + 17x + 25$, which corresponds to multiplying out $(x - (-4 - 3i))(x - (-4 + 3i))(x + 1)$.

C. $b \in [4.9, 8.8], c \in [15.94, 17.54], \text{ and } d \in [-26.86, -23.36]$

* $x^3 + 7x^2 + 17x - 25$, which is the correct option.

D. $b \in [-2.3, 1.9], c \in [2.49, 3.29], \text{ and } d \in [-4.03, -3.82]$

$x^3 + x^2 + 3x - 4$, which corresponds to multiplying out $(x + 4)(x - 1)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-4 - 3i))(x - (-4 + 3i))(x - (1))$.

---

29. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{4}, \frac{7}{2}, \text{ and } \frac{-3}{5}$$

The solution is $40x^3 - 46x^2 - 287x - 147$, which is option A.

A. $a \in [33, 45], b \in [-46, -44], c \in [-295, -277], \text{ and } d \in [-147, -143]$

* $40x^3 - 46x^2 - 287x - 147$, which is the correct option.

B. $a \in [33, 45], b \in [90, 98], c \in [-205, -195], \text{ and } d \in [-147, -143]$

$40x^3 + 94x^2 - 203x - 147$, which corresponds to multiplying out $(4x - 7)(2x + 7)(5x + 3)$.

C. $a \in [33, 45], b \in [35, 50], c \in [-295, -277], \text{ and } d \in [146, 151]$

$40x^3 + 46x^2 - 287x + 147$, which corresponds to multiplying out $(4x - 7)(2x + 7)(5x - 3)$.

D. $a \in [33, 45], b \in [-186, -184], c \in [111, 127], \text{ and } d \in [146, 151]$

$40x^3 - 186x^2 + 119x + 147$, which corresponds to multiplying out $(4x - 7)(2x - 7)(5x + 3)$.

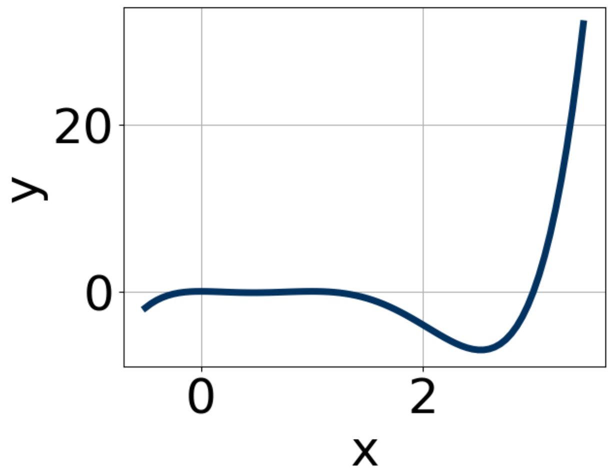
E. $a \in [33, 45], b \in [-46, -44], c \in [-295, -277], \text{ and } d \in [146, 151]$

$40x^3 - 46x^2 - 287x + 147$, which corresponds to multiplying everything correctly except the constant term.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(4x + 7)(2x - 7)(5x + 3)$

---

30. Which of the following equations *could* be of the graph presented below?



The solution is $9x^4(x-1)^{10}(x-3)^9$, which is option C.

A. $6x^9(x-1)^4(x-3)^5$

The factor x should have an even power.

B. $19x^{11}(x-1)^8(x-3)^6$

The factor x should have an even power and the factor $(x-3)$ should have an odd power.

C. $9x^4(x-1)^{10}(x-3)^9$

* This is the correct option.

D. $-8x^{10}(x-1)^8(x-3)^7$

This corresponds to the leading coefficient being the opposite value than it should be.

E. $-11x^4(x-1)^8(x-3)^8$

The factor $(x-3)$ should have an odd power and the leading coefficient should be the opposite sign.

General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).